

## **REMARKS**

Claims 1-8 are pending in this application. In the Office Action mailed June 13, 2007, the Examiner rejects claims 1-8 under 35 U.S.C. 103(a). Applicants have amended independent claim 1 herein to correct a grammatical error, and to clarify that a limitation stated in the last process step, specifically that the "substrate having the admicellar hydrophobic polymer coating thereon has an air permeability substantially the same as the air permeability of an uncoated substrate", applies as a limitation of the claimed substrate. Both amendments are presumably allowable.

### **Response to Rejection of Claims 1-5, 7, and 8**

In the Office Action, the Examiner rejects Claims 1-5, 7, and 8 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,623,015 to Diehl et al., and as being unpatentable over U.S. Patent No. 5,919,716 to Raynolds et al.

As currently amended, claim 1 recites (emphasis added):

1. A substrate comprising a plurality of individual fibers having at least one surface, wherein the at least one surface of the plurality of individual fibers has an **admicellar hydrophobic polymer coating** thereon, wherein the substrate having the admicellar hydrophobic polymer coating thereon has **an air permeability substantially the same as the air permeability of an uncoated substrate**, the hydrophobically coated substrate prepared by the process comprising the steps of:

- providing a substrate comprised of a plurality of individual fibers, each of the plurality of individual fibers having at least one surface;
- providing an aqueous hydrophobic coating composition containing a surfactant and a monomer of a hydrophobic polymer;
- providing an initiator;
- coating the at least one surface of the plurality of individual fibers with the aqueous hydrophobic coating composition;
- introducing the initiator into the hydrophobic coating composition disposed on the at least one surface of the plurality of individual fibers; and
- initiating an admicellar polymerization reaction on the at least one surface of the plurality of individual fibers coated with the aqueous hydrophobic coating composition for a predetermined period of time such that a hydrophobic polymer coating forms on the at least one surface of the plurality of individual fibers, **wherein the substrate having the admicellar hydrophobic polymer coating thereon has an air permeability substantially the same as the air permeability of an uncoated substrate.**

Applicants submit that neither Diehl et al. nor Raynolds et al. disclose or suggest all the limitations recited by amended Claim 1. For example, both Diehl et al. and Raynolds et al. disclose methods of performing emulsion polymerization, but neither reference teaches or suggests an **admicellar hydrophobic polymer coating** as called for by Applicants' independent Claim 1.

"Admicellar polymerization" is defined in detail in paragraphs [0042]-[0044] of the instant specification, and shown schematically in Fig. 4. The three main steps, as defined, are (1) admicelle formation, (2) adsolubilization, and (3) polymerization. Admicelle formation is the adsorption of two layers, i.e., a bilayer, of surfactant onto a surface (see paragraph [0040] and Fig. 4A). The presence of a bilayer can be confirmed by adsorption isotherms and the resulting polymer film by SEM. The polymer film thickness is thus caused to be roughly the same order of magnitude as the surfactant chain length.

In contrast, Diehl et al. and Raynolds et al. teach specific compositions and methods for emulsion polymerization. See, for example, col. 2, lines 26-28 of Diehl et al., and col. 5, lines 48-50 of Raynolds et al. Emulsion polymerization is a technique well known to those skilled in the art and quite distinct from an admicellar polymerization technique. The attached article on Emulsion Polymerization defines "emulsion" as "[a] stable colloidal suspension as milk, consisting of an immiscible liquid dispersed and held in another liquid by a substance called an emulsifier." Emulsion polymerization is then described and depicted on pp. 2-3 of the attached article. In emulsion polymerization, the monomer is present as droplets in the water and also within the micelles. The micelles involved in the emulsion polymerization taught in Diehl et al. and Raynolds et al. are basically

globular solubilizing entities in solution, rather than bilayers on the target surface as with admicelles. (See paragraph 39 of Applicants' specification stating, "The initial feed concentration of surfactant is generally chosen close to but below the critical micelle concentration (CMC) 155 to avoid emulsion polymerization in micelles 70 and to maximize admicelle 120 formation.") "Formally, adsolubilization is defined as the excess concentration of a species at an interface in the presence of the admicelle 120 that would not exist in the absence of the admicelle." (Paragraph 40 of Applicants' specification.) The characteristics of polymer in a micelle are significantly different from polymer in an admicelle, and the resulting product properties reflect these basic chemical, size, and shape differences.

The Examiner takes the position that the property of "having an air permeability substantially the same as the air permeability of an uncoated substrate" is inherently met by the structure taught in Diehl et al. and Raynolds et al. because "the chemical composition of the coating and the structure of the fabric in the instantly claimed invention and those of the reference(s) are identical." Applicants submit that the Examiner's assumption that the coatings are identical is in error for reasons discussed above. In fact, Raynolds et al. actually teaches away from maintaining air permeability in that the Raynolds' invention is for **impregnating non-wovens** and **backcoating wovens** (see, for example, Abstract, col. 10

lines 29-32, claims 2 and 3). The definition of "impregnate" is to "fill throughout; to saturate" (see attached web definition), and "backcoating" means to providing a coating on one side, both of which necessarily reduce the air permeability significantly. Applicants submit that Diehl et al. and Raynolds et al. do not teach or suggest all the limitations of amended Claim 1; therefore, amended Claim 1 is patentably distinguished over in Diehl et al. and Raynolds et al.

Each of claims 2-5, 7, and 8 depend directly from claim 1. Therefore, Applicants submit that claims 2-5, 7, and 8 are patentable over in Diehl et al. and Raynolds et al. for at least the same reasons that Claim 1 is patentable over the cited art. Accordingly, allowance of Claims 1-5, 7, and 8 is respectfully requested.

#### **Response to Rejection of Claim 6**

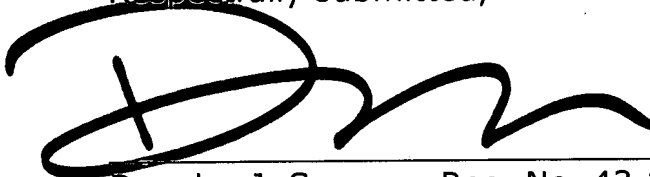
Claim 6 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Raynolds et al. in view of Pickelman et al. (US 4,582,663). As discussed above, Applicants respectfully submit that amended Claim 1 is patently distinguishable over Raynolds et al. Applicants further submit that Pickelman et al. does not disclose or suggest the limitations of Claim 1 which are not disclosed by Raynolds et al. Therefore, amended Claim 1 is patently distinguished over the combination of Raynolds et al. in view of Pickelman et al. Claim 6 depends directly from amended Claim 1. Therefore, Applicants

submit that Claim 6 is patentable over the combination for at least the same reasons that Claim 1 is patentable over the combination. Accordingly, Applicants respectfully request the Examiner withdraw the rejection of Claim 6 and pass this claim to allowance.

### **CONCLUSION**

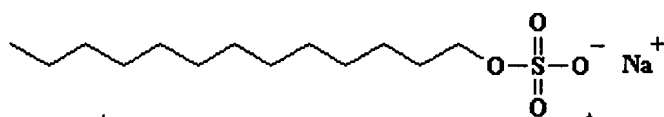
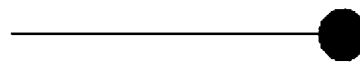
In view of the above, Applicants respectfully suggest the claims are now in a condition for allowance and request issuance of a Notice of Allowance thereof.

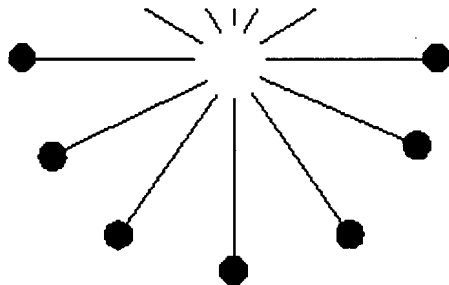
Respectfully submitted,

A handwritten signature in black ink, appearing to read 'D. Sorocco', is written over a horizontal line.

Douglas J. Sorocco, Reg. No. 43,145  
DUNLAP CODDING & ROGERS, P.C.  
P.O. Box 16370  
Oklahoma City, Oklahoma 73113  
Telephone: (405) 607-8600  
Facsimile: (405) 607-8686

Attorney for Applicants

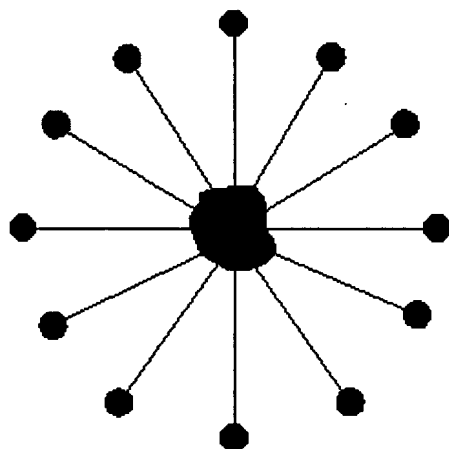
**Keywords****emulsion, soap****by Dennis Parrish****The definition for emulsion is:****"A stable colloidal suspension as milk, consisting of an immiscible liquid dispersed and held in another liquid by a substance called an emulsifier".****In order to understand****emulsion polymerization and emulsifiers, we've got to understand how soap works. Yes, soap! If you already know how soap works and have Grandma's recipe for lye soap, [click here](#) to get to the part on emulsion polymerization. If you're curious, then read on!****Soap's Dirty Job****Soap molecules suffer from a multiple personality disorder, but their dual personalities are always apparent. A soap, or surfactant as it is referred to in emulsion polymerizations, has two ends of different solubility. One end, termed the tail, is a long hydrocarbon that is soluble in nonpolar, organic compounds. The other, the head, is often a sodium or potassium salt, which is water soluble. The water soluble salt can be the salt of a carboxylic acid or sulfonic acid. The technical term for the chemical display of "dual personalities" is *amphipathic*.****nonpolar tail****water soluble head****Sodium Lauryl Sulfate****nonpolar tail****water soluble head****Lazy chemist's representation of  
Sodium Lauryl Sulfate****One soap molecule isn't much good to you. But when you get a whole bunch of 'em together, neat stuff starts to happen. At a certain concentration in water, soap molecules congregate and form micelles. Scientists have an apt (if not original) name for this called the critical micelle concentration, or CMC for short. Don't let the scientists fool you; they're really doin' the hokey pokey, tails inward.**



Any dirt, grease, or grime that you happen to have on your hands is most likely organic and looks like this:



When you wash your hands with soapy water the hokey pokey party really gets goin'. The jubilant dirt particle jumps right in the middle where it's pretty happy. It doesn't want to get out so it stays dissolved in the organic tails of the micelle.



Now the dirt is dissolved in the micelle, and the micelle is dissolved in water, and...Voila! With copious amounts of water, you can wash everything down the drain.

**Party Pooper.**

*Now a question for you: Why is it difficult to take a bath in the ocean?*

### **Finally...Emulsion Polymerization**

In an emulsion polymerization, the soap, or surfactant, is dissolved in water until the critical micelle concentration (CMC) is reached. The interior of the micelle provides the site necessary for polymerization. A monomer (like styrene or methyl methacrylate) and a water soluble free radical initiator are added and the whole batch is shaken or stirred (sorry, James Bond). Emulsion polymerizations are always performed free radically. Anionic and cationic chain ends would be rapidly quenched by the water. The product of an emulsion polymerization is called a latex; does the term "latex paint" ring a bell?



## Location, Location, Location

Once everything is thrown in the pot, the monomer can be found in three different places. First, it can be in large monomer droplets floating around aimlessly in the water. Second, some of the monomer may be dissolved in the water, but this is unlikely. Remember, organic monomers like styrene and methyl methacrylate are hydrophobic. Lastly, the monomer may be found in micelles, which is exactly where we want it. Now look back at the definition at the beginning of this page. The immiscible liquid is the hydrophobic monomer, the mother liquor is water, and the emulsifier is soap.

## Initiation and Polymerization

Initiation takes place when an initiator fragment migrates into a micelle and reacts with a monomer molecule. Water soluble initiators, such as peroxides and persulfates, are commonly used (This also prevents polymerization in the big monomer droplets). Once polymerization starts, the micelle is referred to as a particle. Polymer particles can grow to extremely high molecular weights, especially if the initiator concentration is low. That makes the radical concentration and the rate of termination low as well. Sometimes a chain transfer agent is added to the mix to keep the molecular weight from getting too high.

## Propagation

Monomer migrates from the large monomer droplets to the micelles to sustain polymerization. On average, there is one radical per micelle. Because of this, there isn't much competition for monomer between the growing chains in the particles, so they grow to nearly identical molecular weights and the polydispersity is very close to one. Practically all the monomer is consumed in emulsion polymerizations, meaning the latex can be used without purification. This is important for paints and coatings. Just add some color to the latex, pour it into a can, and it's ready to use.

Here's the neat aspect of emulsion polymerization: each micelle can be considered as a mini bulk polymerization. Unlike traditional bulk polymerizations there is no unreacted monomer leftover, and no thermal "hot spots" form. In bulk polymerizations (no solvent, just monomer and initiator), thermal hot spots cause degradation and discoloration and chain transfer broadens the molecular weight distribution. An increase in temperature sometimes cause the rate of polymerization to increase explosively. The water here acts as a heat sink for all those mini reactors and keeps them from blowing up! Pyromaniacs don't do emulsion polymerizations.

## Molecular Weight

Now this is cool too: The rate of polymerization is the same as the rate of disappearance of monomer. Monomer disappears faster when there are more particles. In order to have more particles there must be more micelles. If the soap sud concentration is increased, this ought to give us more micelles. Now suppose the concentration of initiator is left the same. This will give us more particles and less radicals. What this means is the number of radicals per micelle drops below one. In other words, the rate of termination will be low since there are less radicals. **WHEW!**

So the end result is this: *decreasing the initiator concentration increases molecular weight and rate*

*of polymerization!* This is completely opposite from bulk and solution polymerization. To increase the rate of polymerization for those you have to heat the reaction or increase the initiator concentration, both of which increase the rate of termination and lower the molecular weight.

## Practically Speaking

Sounds neat, but is it useful? Sure is. Poly(vinyl acetate), polychloroprene, polymethacrylates, poly(vinyl chloride), polyacrylamide, and copolymers of polystyrene, polybutadiene, and polyacrylonitrile are made commercially by emulsion polymerization.

## Congratulations!

You've waded through the muck to get this far, unless, of course, you skipped down to the bottom to see if anything cool was here. The set-up now gets paid off with this handy-dandy, easy to decipher table that lists the good and the bad (and, believe me, it's all ugly!).

Polymerization Process	The Good	The Bad
Bulk	Only monomer is present--no extra stuff, High molecular weights	Thermal hotspots, High viscosity, Unreacted monomer present
Solution	Easy temperature control, Control of molecular weight	Must remove solvent, Chain transfer to solvent
Emulsion	All monomer reacts, Latex is usable "as is", Thermally controllable, Can make low Tg materials, Low viscosity	Presence of surfactant may cause water sensitivity

## References and Further Reading

(i.e., more complicated and detailed reading)

Odian, G., "Principles of Polymerization" 3rd Ed., John Wiley and Sons, Inc., New York, 1991.

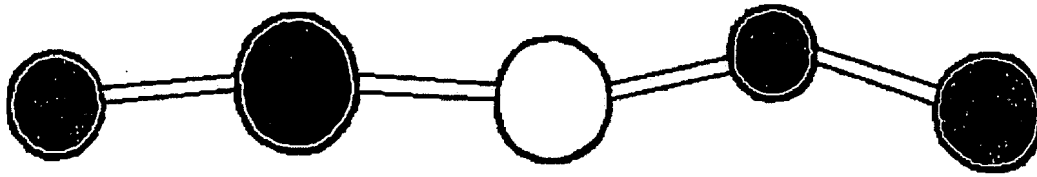
Rosen, S.L., "Fundamental Principles of Polymeric Materials" 2nd Ed., John Wiley and Sons, Inc., New York, 1993.



[Return to Level Four Directory](#)



[Return to Macrogalleria Directory](#)



Copyright ©2005 Polymer Science Learning Center  
University of Southern Mississippi

Department of Polymer Science The